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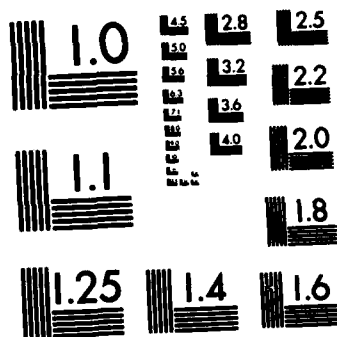
IMPROVED HAWK CERTIFIED ROUND MID-LIFE STATUS REPORT
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IMPROVED HAWK
CERTIFIED ROUND MID-LIFE
STATUS REPORT

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U.S. ARMY MISSILE COMMAND

Redstone Arsenal, Alabama 35809

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IMPROVED HAWK

CERTIFIED ROUND MID-LIFE

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INDEX

1. Chapter I Background
 - a. Basic HAWK Experience, page 1
 - b. Improved HAWK Design Consideration, page 1
2. Chapter II Program Implementation
 - a. Manufacturing Requirements, page 2
 - b. Acceptance and Initial Certification, pages 2-3
3. Chapter III Field Implementation
 - a. Support and Re-Certification, page 4
 - b. Support Center, pages 4-5
4. Chapter IV Enhancement and Missile Performance, page 6
5. Chapter V Further Program Plans, page 7
6. Chapter VI Significant Missile Problems, page 8
 - Problem 1 Gyro Heaters, page 9
 - Problem 2 Humidity Indicator, page 10
 - Problem 3 Actuator Brackets, page 11
 - Problem 4 Side Antenna Moisture Intrusion, page 12
 - Problem 5 Rocket Motor Exit Nozzle, page 13
 - Problem 6 S & A Device Discharge Path, page 14
 - Problem 7 SSLO Drift, page 15
 - Problem 8 G & C "O" Leakage, page 16
 - Problem 9 Intergrate Circuit (IC) APN 10182253, page 17
 - Problem 10 Aft Shear Bolts & Spacers, page 18
 - Problem 11 Missile Corrosion, pages 19-20
 - Problem 12 Actuator Hydraulic Lines (Manifold), page 21
 - Problem 13 Restoration Problems, page 22

INTRODUCTION

This document is intended to summarize the Certified Round Concept as applied to Improved HAWK missile and to provide a detailed description of the Improved HAWK Stockpile Reliability Program. The Stockpile Reliability Program for the Improved HAWK missile is utilized to measure and maintain the reliability of Improved HAWK missiles after deployment and is essential to the implementation of the Certified Round Concept by tactical users. It provides for annual evaluation and recertification of deployed missiles and provides the equipment, skills, and facilities required to perform the corrective actions to maintain the reliability of the certified round after it is deployed. This document further defines the enhancements made to the missile, the problems which have been encountered and associated corrective actions during the first 8 years of deployment and a general description of the program and implementation plans deemed appropriate to complete the life cycle through 1990.

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CHAPTER I

BACKGROUND

A. Basic HAWK Experience

The basic HAWK Missile System developed and deployed in the latter part of the 1950's contained an electron tube missile guidance section. This missile was maintained and repaired in the field through the use of organizational maintenance equipment, field maintenance equipment, and various individual items of test equipment and approximately 2700 repair parts that were available at both the organizational and direct support unit levels. The maintenance test concept employed at that time required the missile to be disassembled, tested and repaired in the field under varying environmental conditions. The exposure of missile guidance section critical components to various environments; numerous tests of the missiles during their useful life; extended run-cycles during standby alerts; workmanship of field personnel during repair and application of MWOs; caused a large number of induced failures. The overall in-flight reliability of the Basic HAWK Missiles during ASP was less than 65% even though the missiles were "checked out" immediately prior to firing. Therefore, the reliability that could be expected in a tactical environment would probably have been much less. All of these factors indicated that a different operational and maintenance concept for the missile was required for any new generation of the HAWK Missile.

B. Improved HAWK Design Considerations

When the Improved HAWK Missile design was contemplated, elimination of all of the foregoing, undesirable, operational characteristics were given a high priority with the intent of "designing them out" of the system. Those design considerations resulted in a solid state electronics guidance section (package) with the inherent qualities of extended component life and greater component stability. Reduced operating time, elimination of field testing, and curtailment of any missile disassembly and modifications in an uncontrolled field environment, were added as operational constraints. The expected operational life of this new missile design was initially estimated as five years based on the individual component aging characteristics, stability, and reliability. The new missile design and use-concept eventually came to be called the Certified Round Missile.

CHAPTER II

PROGRAM IMPLEMENTATION

A. Manufacturing Requirements and Initial Certification

The new missile required a means of initially establishing its capability to meet all of the design characteristics while establishing baseline data that could be used for comparison at later dates. It was determined that a computerized test system could exercise all of the missile's critical flight functions against a simulated radar target in a closely controlled environment (to eliminate the test variability normally associated with temperature and humidity changes). A comprehensive mathematical model of the new test system was prepared and tested. A breadboard model of the proposed test station was designed, built, and installed and proven out at the White Sands Missile Range in New Mexico. The next generation of the design was a production unit installed in Raytheon's West Andover Production Facility as a final acceptance test station for the Improved HAWK Missile. This test station was named Theater Readiness Monitoring Equipment (TRME). It is an abbreviated "hardware in the loop" flight simulation station that was suitable for obtaining the baseline performance data against a standard set of target parameters for the assembled guidance package. The need for a comparable test station or stations which could be deployed in the various theaters of the world, housed in a controlled environment which duplicates the conditions under which the missile was originally built and tested, became an added necessity for the Improved HAWK System to provide for continuous sample testing. These facilities are called Theater Readiness Monitoring Facilities (TRMF's).

B. Acceptance and Initial Certification

Improved HAWK Missiles are produced in discreet blocks or production lots. Acceptance and initial certification of a production lot of missiles is not made until completion of lot acceptance flight test, and is based on all of the process production tests, including 100% static test of guidance packages on the TRME as well as the flight test data of sample missiles. The initial certification starts at the piece part level and continues through final assembly of the missiles. The production test and lot acceptance flight data utilized to make the initial certification also serves as a "data base" that will allow recertification to be based on a comparison of sample data collected by TRMF's and ASP flight results with the initial certification data. Piece Parts used in the Improved HAWK Missiles are those that have been "qualified" for use, either by other application or by special qualification testing. In addition to the "qualification" by "types" there are many parts that are "selected" to meet certain critical parameters that are more strict in tolerance than the standard production

part of the same type. The electronic components are also subjected to screening and burn-in tests and samples of each vendor lot are subjected to construction analysis before release for production of Improved HAWK Missiles. Additional samples are retained in a "parts library" for use in investigation of any problems that may arise at a future time. All data on these tests are retained in a central data bank. Records of piece part test and piece part application through sub-assembly build up and assembly test data is retained in the data bank. Test data on all Government furnished components of the missile is retained in a similar manner at the suppliers of this material.

When missile guidance packages are completely assembled each package is subjected to an initial test on a special set of test equipment called the Production Theater Readiness Monitoring Equipment (PTRME). During PTRME tests the guidance package is operated in a normal flight mode and measurements are taken on over 700 functions of the guidance package. After this initial test, each guidance package is subjected to 16 hrs. operation at high temperature and then monitored for proper operation during shock and vibration at levels in excess of that expected during flights. These tests are intended to induce faults in components or assembly techniques before the missile is delivered. The parameters for these tests were selected and have proven effective in eliminating "infant mortality" problems but are not of sufficient duration to cause "wear out." Upon completion of these tests, the guidance package is subjected to a PTRME Test "for record." This final test provides the baseline data used to compare with future TRMF test data and recertify the missile after deployment. Two guidance packages from each "lot of missiles" are subjected to a series of environmental tests in accordance with the design specification extremes. Since these tests could be detrimental to the service life, these two guidance packages from each production lot are retained in the parts library to serve as samples representative of the assembly process and the component parts used for that lot of missiles. One guidance package is tested in the simulation bay to assess its performance compared to theory and previous lots.

Similar tests are performed on the GFE Missile components and manufacturing records and test records are retained in GFE data banks. GFE items consist of structures and explosives. After missile guidance packages are assembled to GFE components, a sample of missiles from the lot is randomly selected for lot acceptance firing tests. A minimum of three missiles and up to twenty missiles may be fired before the production lot is "accepted" or "rejected." The lot acceptance flight tests are designed to require that the missiles accomplish intercept on a variety of target parameters. The specified levels for reliability and lethality must be met.

The telemetry data reflecting in-flight performance and miss distance is also stored in the data bank for the purpose of comparison with data from ASP flights of missiles from the same lot.

CHAPTER III

FIELD IMPLEMENTATION

A. Support and Re-Certification

The Theater Readiness Monitoring Facility provides the means to obtain the test data necessary for recertification. The Theater Readiness Monitoring Facility is a single facility with built-in temperature, humidity, and dust controls. At the TRMF, tactical missiles (in containers) are decanned, mechanically inspected, disassembled and tested on the Theater Readiness Monitoring Equipment. Should a missile fail during test, a repair test set is provided for troubleshooting and repair of the missile to a subassembly level. The primary objective of the TRMF is to assess the readiness status of Improved HAWK missiles. To evaluate degradation in missile readiness due to handling, aging, and environment, a random sample of missiles is drawn from discrete production lots. Each missile returned to the TRMF is subjected to a series of tests identical to those performed at the factory. The test results are transmitted from the TRMF to the deployment data bank where all lot information is used in a comprehensive trend analysis to provide readiness assessment and to indicate possible future trouble areas. The TRMF may also be used to perform repair of damaged missiles depending upon the extent of damage and to perform missile modifications necessitated by various improvements or retrofits.

B. Support Center

The certified round concept for the Improved HAWK has eliminated the need for 2700 line items in the US Supply Systems. The Support Center which is used in lieu of the DOD supply system for Certified Round, is managed from the Raytheon Company's Plant in Andover, MA. It is currently operated under a MICOM contract with Raytheon Company. Authorized supply load parts are maintained and shipped directly (outside the DOD supply system) to TRMF. Usually, if a defective assembly is found by the TRMF, replacement is available from the in-country TRMF. A replacement to fill in-country TRMF is dispatched to the TRMF and later installed in a missile or added to replenish the in-country stockage. The failed part is then returned to the contractor's plant for failure analysis and repair and stored for reuse only. Fifteen line items have remained in the US supply system consisting of wings, elevons, attaching hardware, and Class V components.

The system described above has effectively maintained the readiness posture of the fielded IH Certified Missile over the past eight years to the extent that no firing battery has entered a Red Status due to lack of ready missiles. This favorable readiness posture and a missile with higher in flight reliability has been achieved at a substantial cost saving, when compared to the Basic HAWK experience as shown by the cost comparison of missile ownership is delineated below:

| Basic HAWK Average Cost/Missile Inventory/Year | | IHAWK Average Cost |
|--|----------------|---|
| Military Technical Support Pers | \$2,315.00 | \$1,044.00 For TRME and CONUS Mgt Personnel (Civs Staff) |
| Repair Parts Support | 446.00* | 418.00 Mgt & Hardware |
| OME/FME Amortization | 347.00 | 105.00 (TRME) Equipment |
| DS/GS Building Amortization (20 yrs) | 17.00 | 105.00 (TRME) |
| Overhaul by Conus Depot | 1,500.00* | 1,400.00* Factory Restoration/ Shelf Life Changeout |
| | <hr/> | <hr/> |
| | \$3,373/yr/msl | \$1,673/yr/msl |

*Due to various differences in shelf life replacement cost no comparison has been shown; however, it is roughly equivalent between basic and improved HAWK. Note that based on a 15 year life of Basic HAWK two overhaul cycles were required, however, based on a 20 year life for Improved HAWK only one overhaul cycle is required.

NOTE:

1. Basic HAWK costs are computed in FY 70 dollars.
2. Improved HAWK costs are computed in FY 80 dollars.
3. The repair parts support for Basic HAWK includes only the Supply Management/Procurement Management Support and Return of Repairable MICOM Managed Items.

CHAPTER IV

ENHANCEMENTS AND MISSILE PERFORMANCE

The Improved HAWK missile did not initially meet the performance requirements against high "G" escape maneuvers and critically spaced multiple targets as they were defined in 1970; however, the user waived the requirement and accepted a lower level performance. During the 1973 time frame it was recognized that HAWK could cope with an expanded threat in the Higher "G" maneuvering target areas if certain modifications were applied. These modifications were designed, tested and a flight program completed in 1974. The results of the engineering flight program and flights of later production missiles confirmed that the new missile capability in the desired areas was approximately double that of the original requirements. Missiles accepted from the production line after April 1975 (missile S/N 410XXX and up) contained these enhancements. A program was established to upgrade missiles produced prior to April 1975. The hardware kit requirements were defined and consisted of new modules for the A5 stick (antenna control) the A6 stick (auto pilot) and reconfiguring the wing and elevon combination. Kit hardware and A5 and A6 sticks were procured in 1976 to support the modification effort.

The wing and elevon reconfiguration alone enhanced the missile capability and could be applied by direct change out at the battery level. In order to obtain the added enhancement resulting from wing/elevon reconfiguration, a separate contract was awarded in 1977 with direct exchange being accomplished between tactical battery and manufacturer.

Continuing review of fielded missile performance data revealed in 1977 that the reliability of early produced lots of missiles were degrading at an approximate 2 1/2 percent per year. This degradation rate would cause the early lots of missiles to approach the minimum acceptable flight reliability threshold approximately 7 years after manufacture or 6 years on site. Shelf life test data confirmed a 7 year shelf life for some of the Class V missile components. In analyzing the total program it was deemed appropriate to restore the missile reliability, exchange the 7 year Class V shelf life components, and apply the electronic enhancements modification concurrently. This program was begun in 1978 and consisted of removing the earlier produced missiles from the tactical batteries through an exchange program. The exchange rate was geared to availability of new production missiles and factory capability to restore, exchange shelf life, and modify earlier produced lots. The program for modification and overhaul will be completed in the 3rd quarter of calendar year 1980 with some missiles modified by TRMF's and others modified at the factory. All missiles with serial number 300XXX through 400XXX which have had the modification applied also have an "E" suffix added to the serial number.

CHAPTER V

PLANS AND IMPLEMENTATION PROGRAM OF CONTINUED FIELD

ASSESSMENT THROUGH THE NEXT PHASE OF LIFE CYCLE

The various stockpile assessment program test data input now confirms that later produced lots (410xxx and up) will not approach the minimum acceptable in flight reliability threshold for approximately 10 years after manufacture. This significant improvement (7 years early lots, 10 years later lots) primarily resulted from hardware maturity. The maturity to a large extent was made possible by full utilization of the Certified Round Data Bank. Shelf life data now confirms a 10 year shelf life on all later produced Class V items. The 10 year shelf life coupled with the 10 year restoration requirement has made possible a coherent program whereby a single restoration and shelf change out program will complete the Improved HAWK Missile life cycle as now forecast. Although the 10 year shelf life now established meets the US Army life cycle requirements; it is planned to be continued in a confirmatory role due to the continuing need for the data by the USMC and the US Government Allies since a much longer life cycle is required. To this end a restructuring of the total Stockpile Reliability Program will be accomplished. This restructuring will consider US Army System Phase out with a continuing requirement for USMC and allied countries. Although the Improved HAWK would continue to fulfill its design threat requirements without enhancement, it now appears that the Improved HAWK Missile could cope, if upgraded by relative inexpensive enhancements, with the expanding ECM threat.

The future enhancement program will be structured in a manner similar to first enhancement program to provide the USER with a missile which will complete the balance of the expected life cycle for the US Army. Additional plans and programs will be developed which will provide a reliable missile to USMC and allies through their expanded life cycle.

CHAPTER VI

SIGNIFICANT MISSILE PROBLEMS

This section is intended to delineate the problems encountered with the Certified Round missile since deployment; discuss the overall impact associated with the problem and provide the problem solution and overall time frame to complete corrective action.

Problem No. 1 - Gyro Heater

A large quantity of Gyro Heaters failed in 300xxx thru 345xxx series missiles. The typical failure mode was the heater becoming open due to the corrosion of the nichrome heater wire caused by residual flux due to inadequate cleaning. The impact on system performance was minimized since redundant heater circuits were used on each Gyro. In the event both heater circuits were open the preheat Gyro requirement could not be met and would normally result in increased miss distance in flight. The interim solution to the problem was accomplished by utilization of field test equipment to detect the problem with problem correction occurring at the TRMF by assembly replacement. The problem was completely resolved by replacing the heater circuits during enhancement, restoration and shelf life change out.

Problem No. 2 - Humidity Indicator

The Humidity Indicator used in 300xxx thru 360xxx missiles had high failure rate. The humidity indicator installed in this series missile utilized a blue colored desiccant which eventually became contaminated by residual hydraulics oil which remained in the Guidance and Control Unit following TRME test. Hydraulic oil contamination occurred at various intervals after the missile was placed on the launcher. The time required for the missile to exhibit this problem was dependent on the amount of movement the launcher was subjected to on site since displacement of the residual oil was required to cause contamination. An oil contaminated indicator was no longer effective in sensing moisture intrusion into the guidance section which caused internal corrosion and RF Frequency Shifts. The interim solution was to replace those contaminated humidity indicators at the TRMF after their discovery during battery inspection by battery personnel. The problem was completely resolved by replacing all humidity indicators in these series missiles with the new design during enhancement, restoration and shelf life change out.

Problem No. 3 - Actuator Brackets

The actuator brackets used on missiles 300xxx thru 400xxx presented a fit problem when loading the missiles on a launcher. The typical failure mode was a tolerance stackup between the slot in the actuator bracket and the launcher button hook. When the tolerance stackup did occur, either from installing new missiles on the launcher or changing launcher button hooks, damage would occur on the missile. The most likely portion of the missile to be damaged was the tail cone; however, in some cases missiles were dropped causing extensive damage to the missile. The impact on the system was the loss of missiles for tactical use during the extended repair cycle. The interim solution to the problem was to supply gages, replacement brackets, and tools to each theater. The problem was completely resolved during enhancement, restoration and shelf life change out by replacement of all questionable brackets.

Problem 4 - Side Antenna Moisture Intrusion

A large quantity of side antennas on missiles 300xxx through 410xxx leaked when subjected to field environments. The typical failure mode for this series missiles was debond of the side antenna radome from the wave guide. The debonding occurred due to the continuous retraction and expansion of the radome when subjected to changing humidity and temperature environments. The impact on system performance is associated with possible in flight failure due to RF attenuation from moisture intrusion or possible internal corrosion in the waveguide. Because of missile to target intercept variations only one third of the missiles fired with moisture in a side antenna would be adversely affected. A rigid inspection was implemented in the field and defective antennas were replaced at the TRMF. Beginning with missile 420xxx a new adhesive, FM-1000, having a higher bond strength than the old adhesive, was implemented into production. The high strength adhesive eliminated one form of the debond problem, but surfaced another cause of debonding, i.e., when moisture attacks the epoxy to metal interface, turning the aluminum oxide into a hydroxide which results in lifting of the adhesive. An additional corrective action was implemented late in production to add a moisture resistant coating known as "belt and suspenders" which has minimized the problem. All side antennas on missile 300xxx through 400xxx have had both the high strength adhesive and "belt and suspenders" added during enhancement, restoration and shelf life change out. To compensate for the field missiles which have not had the "belt and suspender" added, a vacuum leak tester has been provided to each TRMF. When defective side antennas are identified they are replaced and returned to the factory for repair. The highest margin solution to this problem seems to be a Boeing anodizing technique coupled with supplementary coatings and will be applied if necessary during the second half of the life cycle.

Problem 5 - Rocket Motor Exit Nozzle

The exit nozzles used on missiles 380xxx thru 420xxx exhibited cracks. The typical failure mode is cracking and chipping of the phenolic liner following a curing cycle. The cause of the cracking is attributable to the ovality of the metal cone, the type fiber used in the liner, and the curing method utilized. Numerous test firings under various conditions were conducted and field reject/accept criteria was developed. A relining program for cracked exit nozzles was implemented to provide for field exchange for those nozzles that did not meet field criteria. The balance of the missile in series 300xxx thru 400xxx had exit nozzles exchanged during enhancement, restoration and shelf life change out. Additional field inspection and exist nozzle exchange will be accomplished on missile series 410xxx and 420xxx. The production problem was solved at missile s/n 430xxx by adding the ovality requirement to the metal cone, changing the type fiber and implementing a new curing method.

Problem 6 - Safety and Arming Device Discharge Path

During early 1975 a sneak discharge path was discovered between the S & A and Guidance Control.

In order for the problem to occur, the missile must not obtain a reference lock prior to S & A "G" Arm thereby allowing the self destruct capacitor to discharge through a 2K ohm load provided in the guidance section to shape and feed the pulse to telemetry. With the capacitor discharged the missile command destruct capability is lost to the range safety office. This condition presents a safety hazard when missiles are fired on controlled ranges. New circuitry was designed and incorporated into an encapsulated interface device known as a range safety module. This circuit provides a DC voltage block on the capacitor discharge path to the 2K ohm load and discharge resistor which requires 7 seconds for the capacitor to discharge to a voltage level that is insufficient to detonate the warhead. The RC network assured that if reference lock was not achieved by "G" Arm, the missile would self destruct.

As an interim fix, the range safety module was applied at the TRMF to missiles selected for range firings. The range safety module was later installed during production and in missiles being processed for enhancement restoration and shelf life change out. In addition, the range safety module is applied to all missiles processed at the TRMF. There was no tactical impact as a result of this problem.

Problem 7 - Solid State Local Oscillator (SSLO) Drift/Hyd Oil Penetration

Missile S/N 300XXX thru 500XXX have exhibited SSLO frequency drift and Hydraulic Oil Penetration. The typical failure mode is frequency drift in a negative direction. The drift rate of the SSLO has been 1 1/2 to 2 1/2 mega Hz per year. The problem occurs when the SSLO drifts to the extent that the missile cannot acquire reference lock from the designated HPI. When this condition exists missile self destruct will occur at S & A "G" Arm. A new factory SSLO frequency setting was implemented and a sealing method developed to avoid or minimize the SSLO drift. All SSLO's processed across the TRME repair test set are measured at 3 frequency points (AO, A+ and A-) to assure the SSLO frequency is within the 10 mega Hz of center value although there is no field problem until the SSLO is more than 17 mega Hz from center. SSLO's which do not meet the specification are returned to the factory for recentering and sealing. All missiles processed for enhancement, restoration and shelf life change out had the SSLO brought within the 10 mega Hz requirement and received the sealing. Missiles returned during the second 1/2 life cycle will also have the SSLO problem resolved.

Problem 8 - G & C "O" Ring Leak

Missiles SN 300XXX through 500XXX had "O" rings which would allow some leakage at the radome seal and connector seals. The typical failure mode was caused by changes in temperature which allowed moisture to enter the G & C at the seals. Moisture entering the G & C causes a negative frequency change in the SSLO within the missile as well as creating some internal corrosion. This condition has the potential of severely affecting missile performance both from frequency shifts and corrosive affects. To alleviate this condition, a new "O" ring design was introduced for the radome to gimble ring seal and for the connector to G & C seals. Additionally a radome bake fixture was designed and manufactured. This radome drying fixture allows a vacuum to be maintained while the moisture is being removed from the fiber glass radome. The radome in the total dry condition acts as a desiccant for the total G & C. A new leak test requirement with associated unique measuring equipment was introduced. The requirement imposed today is ten times more stringent than the leak rate allowed on earlier produced missiles. The new "O" rings, radome bake station, and leak test are now in use by all TRMF's. All missiles processed for enhancement, restoration and shelf life change out received new "O" rings, a dried radome, and meet the new leak test requirements. Missiles returned during the second 1/2 life cycle will have the same moisture intrusion corrective actions applied.

Problem 9 - Intergrated Circuit (IC) APN 10182253

The hybrid IC APN 10182253 installed in 360XXX through 391XXX missiles exhibited an internal interconnection problem. The typical mode of failure was an open interconnection at the bond between the aluminum wire and the gold metallization. The problem was caused by the use of a glass fritted gold metallization during manufacture which resulted in reduced metal to metal contact in the bond causing intermittent interconnection internal to certain IC's. The 380XXX series missiles were recalled and screened for this problem. This problem resulted in a decrease in performance by potentially causing inflight missile failures. This IC is used in 24 applications within the missile and affects many G & C functions.

As an interim fix a screening program was implemented at the TRMF to isolate and remove assemblies containing defective IC's.

The IC's manufactured with the potential intermittent problem were removed from all 24 applications during enhancement, restoration and shelf life change out.

Problem 10 - Aft Shear Bolts and Spacers

The aft shear bolts and spacer used to attach the wing to the rocket motor are extremely susceptible to corrosion and seizure following long exposure to the environments. The problem is compounded by the fact that the bolt used to attach the elevon to the wing is the same diameter and thread, but somewhat longer. When the two bolts are interchanged (wrong application) two very severe problems exist. First, the shorter bolt does not adequately secure the elevon to the wing out board strut. This condition would, under certain conditions result in a flight failure. The second problem encountered by misapplication of the bolts is that the long bolt does not properly seat in the rocket motor. When an attempt is made to completely engage the long bolt the rocket motor case is distorted around the aft closure. This condition results in pressure chamber leakage and safety hazard when the missile is fired.

To alleviate the condition a new aft shear bolt and spacer was designed to preclude misapplication and also provide environmental protection for the bolt and spacer. The TRMF is now using the new bolt and spacer. Tactical user retrofit will be accomplished by 1 Nov 80.

Problem 11 - Missile Corrosion

Missiles deployed in certain high salt fog environments have exhibited external corrosion. Missile areas exhibiting this corrosion are:

1. All missile section attach holes and screws.
2. Nut plates.
3. Actuator section and hydraulic lines.
4. Rear antenna.
5. Missile present switch.
6. Missile arming handle.
7. Tunnel clips.
8. Wing and actuator attach bolts.
9. Bathtub connector screws.
10. Gyro housing covers.
11. Radome lock.
12. 270 waveguide.
13. Side antennas.
14. Warhead bolts.
15. Exit nozzle.

Investigations and tests have shown that missiles processed in accordance with the technical data package (TDP) will withstand 132 hours in salt fog environment tests and the TDP only requires them to withstand a 50 hour test. These tests and related investigations show that the finishes being applied to the missiles provide approximately 2.5 times the required protection and are adequate for most environments.

Based on reports from two or three locations that have extreme salt fog environments, special finishes and processes were developed. These finishes and processes were subjected to more than 1000 hours of salt fog testing which indicated that they provided protection for approximately 800 hours or 6 times as long as provided by normal production finishes (132 hours).

Corrective action for the problem consisted of furnishing the processes and procedures for application to the locations that experienced the problem. These locations can apply the protective finishes at a TRMF on present assets. The protective finishes can be applied during production (additional cost) or at TRMF on any future procurements. There is no plan to change the TDP finish requirements on the missile at the present time as it is adequate in most environments.

Problem 12 - Actuator Hydraulic Lines (Manifold)

Missiles SN 380XXX thru 500XXX are exhibiting a problem with the actuator hydraulic lines. The typical failure mode for these hydraulic lines is weakening of the metal due to intergranular corrosion with rupture occurring in cases of severe corrosion when hydraulic pressure is applied. The problem resulted from the cooling process used after brazing during manufacture of the lines. The first indication of the problem is evident by slight corrosion or rust appearing on the hydraulic lines. The rupture problem normally appears after the hydraulic lines are 4 1/2 to 5 1/2 years of age. Rigid inspection procedures have been added at the TRMF. Additionally a structural pressure screen (increase of 33%) is being implemented to increase the confidence level that the hydraulic lines have reserve margin for redeployment. Replacement of the hydraulic lines is planned consistent with the 4 1/2 to 5 1/2 year time frame. Missiles processed for enhancement, restoration and shelf life change out received 100% proof pressure inspection and were changed out if any visual defect was present.

Problem 13 - Numerous Problems Corrected at Restoration

Many problems of less severe magnitude were corrected during enhancement and restoration, for example, replacing suspect Dale resistors, replacing corroded Viking connectors, etc. Such problems required replacement of components on a select basis. It is planned to continue this type restoration program during the remaining life cycle.

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